National Energy Board | Office national de l'énergie

FOCUS ON
SAFETY AND ENVIRONMENT
A COMPARATIVE ANALYSIS OF PIPELINE PERFORMANCE
2000-2009

DECEMBER 2011

Canada

National Energy Board

Office national de l'énergie

Focus on Safety and Environment

A Comparative Analysis of Pipeline Performance

2000–2009

December 2011

Canada

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TABLE OF CONTENTS

List of Figures and Tables ii

List of Acronyms and Abbreviations iii

Foreword iv

Overview of Safety and Environmental Performance Indicators v

1. Introduction 1
- 1.1 NEB Safety Role 1
- 1.2 2000 – 2009 Pipeline Performance Indicators 1
- 1.3 Reference Organizations 2

2. Pipeline Safety Performance 3
- 2.1 Pipeline Fatalities 3
- 2.2 Injuries 3
- 2.3 Detailed Injury Analysis 4
- 2.4 Safety Inspections 7
- 2.5 Pipeline Ruptures 7
- 2.6 Unauthorized Activities in Pipeline Rights of Way 11

3. Pipeline Environmental Performance 13
- 3.1 Liquid Pipebody Releases 13
- 3.2 Liquid Release Frequency Comparisons 14
- 3.3 Liquid Release Volume Comparisons 15
- 3.4 Operational Liquid Leaks 15
- 3.5 Non-Pipeline Liquid Spills 16
- 3.6 Gas Releases and Operational Gas Leaks 16
- 3.7 Gas Release Frequency Comparison 17
- 3.8 Operational Gas Leak Frequency 18

4. NEB-Regulated Pipeline Performance Indicator Summary 19

5. Looking Ahead 20

Appendix One
- Pipeline Performance Indicator Data 21

FIGURES

2.1	Injury Frequency	4
2.2	Liquid Pipeline Injury Frequency	5
2.3	Gas Pipeline Injury Frequency	5
2.4	Employee Injury Frequency	6
2.5	Contractor Injury Frequency	6
2.6	2009 NEB Pipeline Safety Inspections Non-Compliances	8
2.7	NEB-Regulated Pipeline Ruptures 1991 – 2009	9
2.8	NEB-Regulated Pipeline Rupture Causes	10
2.9	Pipeline Rupture Cause Comparison	10
3.1	Pipebody Liquid Release Frequency	14
3.2	Pipebody Liquid Release Volume	15
3.3	Pipeline Operational Liquid Leak Frequency	16
3.4	Pipebody Gas Release Frequency	17
3.5	Operation Gas Leak Frequency	18

TABLES

2.1	Cumulative Serious Injuries 2000 – 2009	7
2.2	Contractor Serious Injury Causes 2000 – 2009	8
2.3	Unauthorized Activities on NEB-Regulated Pipeline Rights of Way	12
3.1	Pipebody Liquid Releases	13
3.2	Liquid Release Reporting Criteria	14
3.3	Pipeline Operational Leaks	15
3.4	Non-Pipeline Liquid Spills	16
3.5	Pipeline Gas Releases and Leaks	17
3.6	Pipeline Gas Release Reporting Criteria	17
4.1	NEB-Regulated Pipeline Performance Indicator Summary	19
A1.1	Companies Reporting Performance Indicator Data for 2009	21
A1.2	NEB-Regulated Pipeline Kilometres	22
A1.3	Pipeline Contractor and Employee Injury Frequency Raw Data	22
A1.4	Gas and Liquid Pipeline Worker Hours	22
A1.5	Reference Organization Pipeline Lengths	23
A1.6	Reference Organization Injury Frequency Data	24

CAPP	Canadian Association of Petroleum Producers
CLC	*Canada Labour Code, Part II*
CONCAWE	European Oil Companies Association for Environment, Health and Safety
CSA	Canadian Standards Association
EGIG	European Gas Pipeline Incident Data Group
ERCB	Energy Resources Conservation Board (formerly Alberta Energy and Utilities Board)
HRSDC	Human Resources and Skills Development Canada
NEB	National Energy Board
OPR-99	*Onshore Pipeline Regulations, 1999*
PHMSA	Pipeline and Hazardous Materials Safety Administration

FOREWORD

This report, *Focus on Safety and Environment: A Comparative Analysis of Pipeline Performance, 2000-2009*, examines the number and frequency of various incidents that affect pipeline safety, integrity and the environment. The objective of this report is to present safety and environmental performance indicators of NEB-regulated onshore pipelines and to compare the data to those of other jurisdictions.

The first of the NEB's annual performance indicators reports, *Focus on Safety: a Comparative Analysis of Pipeline Safety Performance*, was published in April 2003. This ninth edition of the report includes data from 1 January 2000 through 31 December 2009.

The NEB continually seeks input and feedback from stakeholders on the value of this report and ways it can be improved. Any comments or questions pertaining to this report should be directed to:

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OVERVIEW OF SAFETY AND ENVIRONMENTAL PERFORMANCE INDICATORS

The National Energy Board has been regulating pipelines so that they are safe, secure and environmentally responsible since 1959. While much has changed since then, safety and environmental protection are of paramount importance to the NEB.

Injury Rate

NEB-regulated pipeline workers are experiencing fewer on-the-job injuries. The 10-year historical average shows 1.1 injuries reported for every 100 full-time equivalent workers. In 2008, this rate decreased to 0.99 injuries and to 0.53 injuries for every 100 full-time workers in 2009.

Traditionally, contract workers are hurt on the job more often than regular, full-time workers. In 2008 this remained the case with 1.16 injuries reported for every 100 full-time equivalent contractors versus 0.68 reported for every 100 full-time employees. In 2009 contractors reported 0.53 injuries compared to 0.57 reported for employees.

There was a drop in the injury rate for liquid pipeline workers in 2009. There were 1.63 injuries reported for every 100 workers in 2007. In 2008, this rate dropped to 1.37 and to 0.47 injuries for every 100 full-time workers in 2009. Those working on gas pipelines reported 2.16 injuries for every 100 full-time workers in 2007. This rate dropped to 0.59 in 2008 but rose to 0.69 injuries for every 100 full-time workers in 2009.

There were no work-related fatalities on NEB-regulated pipelines in 2009. In addition, no member of the general public has been hurt by a NEB-regulated pipeline during the review period.

Liquid Spills

In 2008, there were no spills from a pipebody on liquid pipelines. In 2009, this rate rose to 0.1 pipebody liquid spills for every 1,000 kilometres of NEB-regulated pipeline. This is equivalent to the 10-year average reported for liquid pipelines. The amount of liquid hydrocarbons that was released has increased as well. In 2009, 86.1 m^3 of product was released from the pipebody for every 1 000 kilometres of pipeline. The 10-year average for pipebody liquid spills is 41.8 m^3 per 1 000 kilometre.

The operational liquid leak frequency also increased from two leaks per 1 000 km in 2008, to four leaks per 1 000 km in 2009.

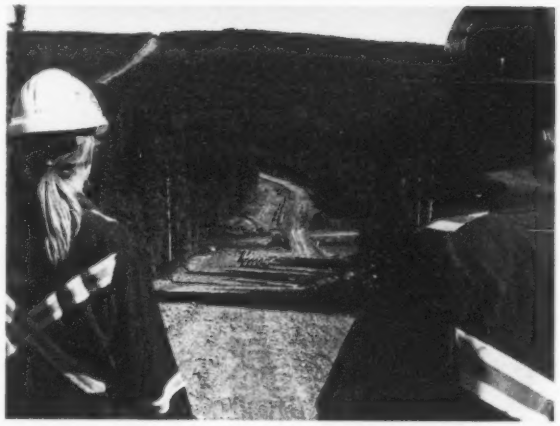
Gas Releases

The number of releases from a natural gas pipebody release decreased from 0.2 releases per 1 000 km of pipelines in 2008, to 0.1 in 2009. The 2009 rate is equivalent to the 10-year average reported for gas pipelines.

Operational gas release frequency decreased from 1.2 releases per 1 000 km in 2008, to 1.0 per 1 000 km in 2009; however, the 2009 frequency remains slightly higher than the 10-year average of 0.9.

INTRODUCTION

1.1 NEB Safety Role



In 2009, the NEB regulated 119 hydrocarbon pipeline companies that operate approximately 72 000 kilometres of pipelines across Canada under the *National Energy Board Act* and the *Onshore Pipeline Regulations, 1999* (OPR-99). This network includes large diameter, small diameter, high-pressure natural gas, crude oil, and oil products pipelines.

The NEB gathers information on performance indicators that relate to safety and environmental impacts through both compulsory reporting on a per incident basis and on an annual voluntary basis, for all pipelines regulated through the OPR-99. The following performance indicators are tracked:

- fatalities;
- injuries;
- pipeline ruptures;
- pipeline contacts;
- liquid releases, leaks and spills; and
- gas releases.

The voluntary performance data are normalized on the basis of pipeline length and hours worked, allowing for annual comparisons, as well as comparisons with other organizations. The NEB compiles this annual report in order to provide a historic trend analysis.

1.2 2000 – 2009 Pipeline Performance Indicators

Analyzing these voluntarily reported data helps both the NEB and its regulated companies to monitor safety and environmental performance. The information gathered for this report represents data to 31 December 2009. A list of companies that have voluntarily reported environmental and safety information for 2009 is provided in Appendix One, Pipeline Performance Indicator Data.

In 2009, reporting by pipeline companies showed that several performance indicators have improved since 2008. From a safety perspective, injury frequencies for both contractors and employees decreased in 2009, returning to levels comparable to those reported in 2004 and 2005. Safety performance indicators are discussed in detail in Chapter Two of this report.

Regarding environmental protection, two pipebody liquid releases (releases originating from the pipe itself, excluding fittings) were reported, and the number of other major pipeline and non-pipeline spills and liquid leaks remained approximately equal to those reported in previous years. Additionally, there were five natural gas pipeline ruptures on NEB-regulated pipelines in 2009. Environmental performance indicators are discussed in detail in Chapter Three of this report.

In this report, the term "pipeline" includes all branches, extensions, tanks, reservoirs, storage facilities, pipes, pumps, valves, racks, compressors and loading facilities integral to the operation of a hydrocarbon pipeline.

1.3 Reference Organizations

Where comparable data are available, the NEB compares performance indicators with that of other agencies. These external data are taken from publicly available documents provided on websites and in published reports. The following organizations have been selected for comparison in this report:

CAPP:	Canadian Association of Petroleum Producers; www.capp.ca
CONCAWE:	Conservation of Clean Air and Water in Europe; European Oil Companies Association for Environment, Health and Safety; www.concawe.be
EGIG:	European Gas Pipeline Incident Data Group; www.egig.nl
ERCB:	Alberta Energy Resources Conservation Board; www.ercb.ca
HRSDC:	Human Resources and Skills Development Canada; www.hrsdc.gc.ca
PHMSA:	United States Department of Transportation – Pipeline and Hazardous Materials Safety Administration - Office of Pipeline Safety; http://phmsa.dot.gov

PIPELINE SAFETY PERFORMANCE

The NEB recognizes the efforts regulated companies and their contractors make to operate safe workplaces. That being said, the nature of the industry and the number of persons working within it pose a continuous risk. In order to reduce risk to the public and workers, proactive safety management and a culture of safety must be values and priorities for industry.

2.1 Pipeline Fatalities

Fatality data provided by NEB-regulated pipeline companies are evaluated to determine if each incident involved employees, contractors or members of the public and whether they involved activities related to the construction, operation or maintenance of pipelines.

Between 1991 and 1997 five contract workers conducting construction activities were killed on NEB-regulated pipelines. For the next ten years, there were no work-related fatalities reported to the NEB, though several thousand kilometres of new pipeline was constructed and existing pipelines were expanded during that period. Two fatalities were reported in 2008; one involved a contractor conducting construction activities, while the second involved an employee performing an operation and maintenance activity. There were no work-related fatalities on NEB-regulated pipelines in 2009.

2.2 Injuries

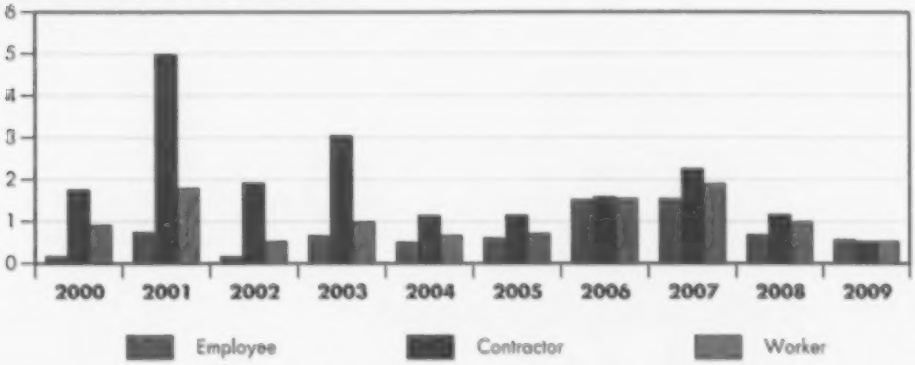
Injury frequency data are reported through a combination of mandatory reporting under the OPR-99 and voluntary reporting under the SPI initiative. Therefore the data includes all lost time and restricted workday injuries, but exclude fatalities. For this report, injury data submitted by NEB-regulated companies have been separated into three categories:

1. Employee Injuries
   These are injuries that occur while an employee is involved in activities associated with their job duties. Employee data from NEB-regulated pipelines do not include head office staff but do include staff from other facility offices.
2. Contractor Injuries
   These are injuries that occur while a contract worker is involved in activities pursuant to their contract with a pipeline company. Contractor data include contractors performing activities related to the construction, operation, or maintenance of NEB-regulated pipelines.
3. Worker Injuries
   These are an aggregate of the above two categories: employee and contractor injuries. These results are shown in Figure 2.1. All injury frequencies are measured in terms of injuries per 200 000 hours of work. This measurement is widely used in the health and safety industry and is equivalent to the number of hours worked by 100 full-time employees in one year. Worker injury frequency decreased from 1.0 injuries per 200 000 hours in 2008 to 0.53 in 2009.

FIGURE 2.1

Injury Frequency

Number of injuries per 200,000 hrs



2009 was a heavy construction year for the pipeline industry, with employees and contractors working nearly twice as many hours as they worked in 2008, also a heavy construction year. The injury frequency decreased significantly from 2007 to 2008 and continued to decrease in 2009. However, the Board remains concerned about the number of injuries sustained by workers in the pipeline industry. Continual improvement is important. A summary of employee and contractor hours and the number of injuries incurred since 2000 is provided in Appendix One - Pipeline Performance Indicator Data.

2.3 Detailed Injury Analysis

To better understand reported injury frequencies, data have been separated by contractor and employee and by liquid and gas pipelines. In addition, the types of serious injuries suffered by contractors and their causes, as well as safety non-compliances observed by NEB inspectors have been evaluated.

NEB-Regulated Liquid Pipeline Injuries

Liquid pipelines include crude oil, refined product and NGL pipelines. Contractor, employee and worker injury frequencies for NEB-regulated liquid pipelines are shown in Figure 2.2. No injuries were reported in 2002 on liquid pipelines.

The contractor injury frequency has historically been higher than that of company employees, increasing steadily from 2004 through 2007, however this trend did not continue in 2008 and 2009. The employee injury frequency for liquid pipelines has been relatively low for the past eight years. The Board observed an increase in the frequency of employee injuries from 2007 to 2008, and then a decrease from 1.37 in 2008 to 0.58 in 2009. The contractor injury frequency of 0.46 injuries per 200 000 hours worked on liquid pipelines in 2009 is a reduction of 34 per cent over the 2008 frequency of 1.37 and a reduction of 84 per cent over the 10-year average of 2.93.

NEB-Regulated Gas Pipeline Injuries

Gas pipelines include natural gas, both sweet and sour and high vapour pressure product pipelines. The injury frequency for all workers including contractors and employees for NEB-regulated gas pipelines is shown in Figure 2.3.

FIGURE 2.2

Liquid Pipeline Injury Frequency

Number of injuries per 200 000 hrs

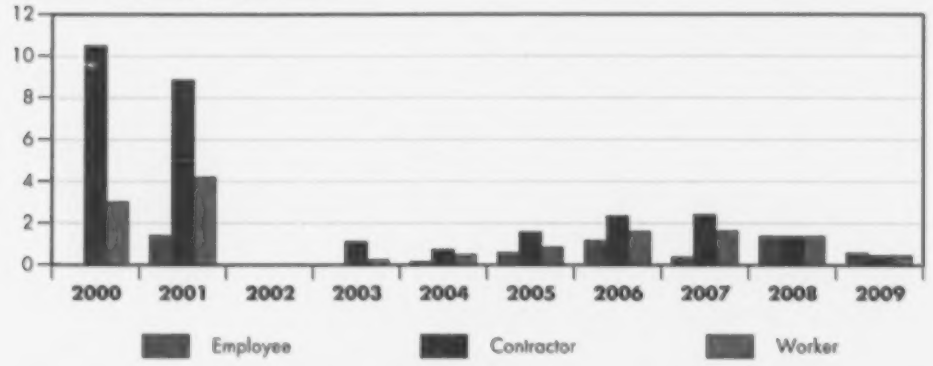
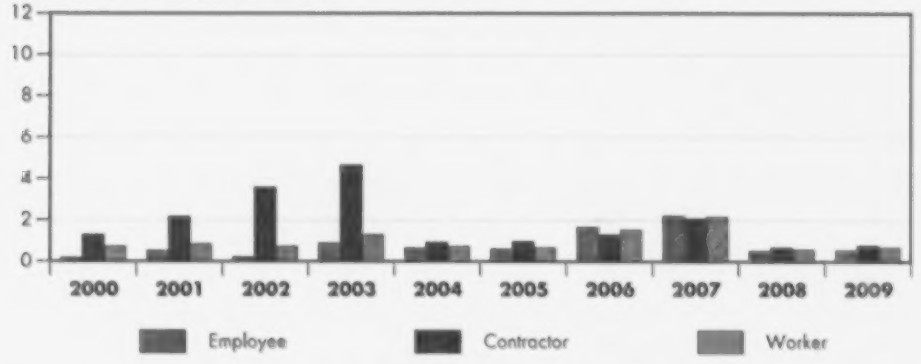


FIGURE 2.3

Gas Pipeline Injury Frequency

Number of injuries per 200 000 hrs



The gas pipeline employee and contractor injury frequencies both increased in 2009. The employee injury frequency increased from 0.52 in 2008 to 0.57 in 2009. Contractor injury frequencies increased from 0.68 in 2008 to 0.78 in 2009. The Board observes that the 2009 frequencies remain below the ten-year averages of 0.80 and 1.84, for employees and contractors respectively.

Employee Injury Frequency Comparisons

NEB-regulated pipeline employee injury frequencies are compared to reference organizations Human Resources and Skills Development Canada (HRSDC) and the Canadian Association of Petroleum Producers (CAPP) for the period 2000 to 2009 in Figure 2.4. NEB-regulated pipeline companies show a marked increase in the number of employee injuries between 2005 and 2007, while the CAPP reported frequency decreased. In 2008, the employee injury frequency fell by 56 per cent; this reduction to 0.68 is now more consistent with the reported CAPP frequency of 0.64. CAPP data were not available for 2009 at the time of this comparison.

HRSDC publishes employee injury frequency data, which include disabling injuries to employees, both in the field and in head and regional offices, for all federally regulated workplaces.

NEB-regulated pipeline employee injury data do not include head offices. The HRSDC pipeline employee injury frequency for 2000 to 2007 ranged from 0.3 to 0.6 injuries per 200 000 hours. HRSDC data were not available for 2008 or 2009 at the time of this comparison.

Contractor Injury Frequency Comparisons

A comparison of contractor injury frequencies relative to CAPP data from 2000 through 2008 in Figure 2.5 show that NEB-regulated pipeline injury frequencies were on average, similar to those reported by CAPP. The NEB nine-year average indicates that approximately two out of 100 full-time contract workers were injured every year. CAPP data for 2009 were not available at the time of this comparison.

FIGURE 2.4

Employee Injury Frequency

Number of Injuries per 200 000 hours

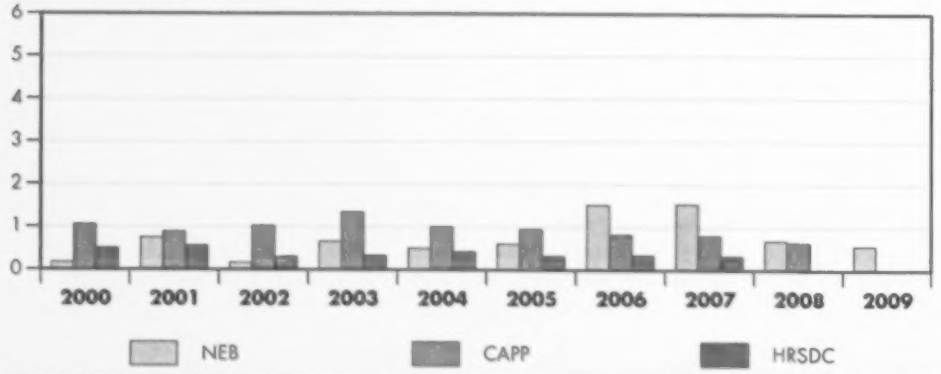
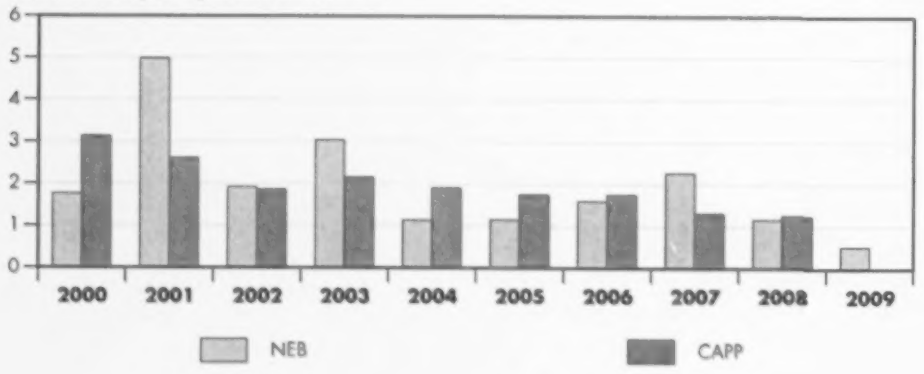


FIGURE 2.5

Contractor Injury Frequency

Number of Injuries per 200 000 hours



Contractor Serious Injuries

The types of serious injuries incurred by contract workers on NEB-regulated pipelines and reported between 2000 and 2009 are categorized in Table 2.1. Serious injury is defined as an injury that results in:

- the fracture of a major bone;
- the amputation of a body part;
- the loss of sight in one or both eyes;
- internal haemorrhage;
- third degree burns;
- unconsciousness; or
- the loss of function of a body part.

TABLE 2.1

Cumulative Serious Injuries 2000 – 2009

Type of Event or Exposure	Number of Serious Injuries
Contact with Objects & Equipment	
Struck by Object	9
Caught in Object	5
Struck against Object	1
Contact with Electricity	2
Other	0
Falls	
Fall on Same Level	0
Fall to Lower Level	4
Other	0
Transportation Accidents	2
Fire and Explosions	0
Total Number of Serious Injuries	23

In 2009 seven serious injuries were reported, five of which were suffered by contractors, and two of which were suffered by employees. The Board observes that contractors suffer a disproportionate number of serious injuries compared to employees, even though the contractor injury frequency for all injuries has decreased in 2007, 2008 and 2009, and is now slightly lower than employee injury frequency for 2009.

The longer-term trend for contractor injury frequency is, on average, higher than that of employees. Preventative measures such as hazard assessments, proactive safety management programs and worker education should be designed to reduce any increased risk. The NEB has conducted further analysis on the causes of these contractor incidents as shown in Table 2.2.

2.4 Safety Inspections

As part of its commitment to monitor compliance with the OPR-99, safety regulations and associated technical standards, the NEB regularly inspects pipeline construction projects and operating pipelines under its jurisdiction. When contraventions of the *Canada Labour Code* (CLC) or OPR-99 are noted during inspections they are often corrected immediately, while the NEB inspector is onsite. Those which are not immediately corrected receive continued attention and follow-up after the inspection is complete. All contraventions are recorded and tracked so that the NEB and the industry may pay special attention to areas of concern. This allows the NEB and its regulated companies to apply a proactive approach to incident prevention and overall safety management. The non-compliances observed during NEB safety inspections in 2009 are shown in Figure 2.6.

In 2009, the three most common non-compliances were: safety equipment inadequately maintained or missing (safety equipment includes machine guards, guardrails, toe boards etc.); hazardous product storage or usage- related non-compliances; and housekeeping-related non-compliances.

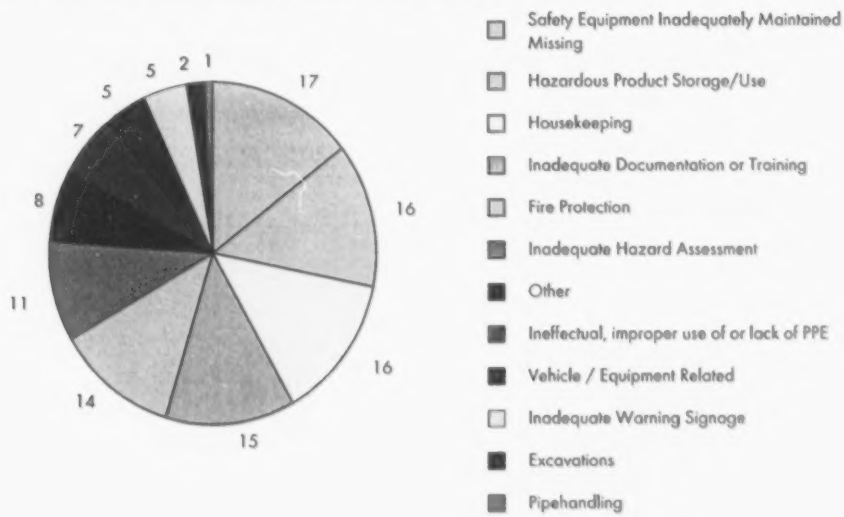
TABLE 2.2

Contractor Serious Injury Causes 2000 – 2009

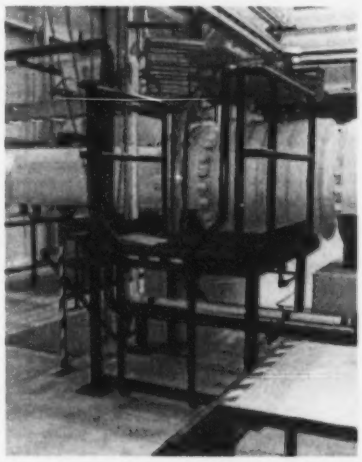
Direct Causes		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Substandard Acts	Improper position for task		1			1					2	4
	Improper placement	1	1		1			1		1	1	6
	Using equipment improperly		1				1				2	4
	Failure to warn	1										1
	Failure to secure				1				2	1		4
	Failure to follow procedures						1					1
Substandard Conditions	Hazardous environmental conditions						1					1
	Inadequate sign or label					1						1
Total Injuries		**2**	**3**	**0**	**2**	**2**	**3**	**1**	**2**	**2**	**5**	**22**
Basic Causes												
Job Factors	Inadequate leadership/supervision	1	2									3
	Inadequate tools and equipment				1				1	1	1	4
	Inadequate work standards				1	1					1	3
	Inadequate engineering						1		1			2
Personal Factors	Poor Judgment		1				1	1			2	5
	Lack of knowledge						1			1	1	3
	Improper motivation	1				1						2
Total Injuries		**2**	**3**	**0**	**2**	**2**	**3**	**1**	**2**	**2**	**5**	**22**

FIGURE 2.6

2009 NEB Pipeline Safety Inspections Non-Compliances



2.5 Pipeline Ruptures



Ruptures are defined as a "loss of containment event that immediately impairs the operation of a pipeline". Pipeline ruptures have the potential to be severely detrimental to the environment and to public and worker safety. Pipeline ruptures are always investigated to determine their primary cause. The number of NEB-regulated pipeline ruptures since 1991 and their primary cause are shown in Figure 2.7 These are considered to be both safety and environmental performance indicators.

Between 1991 and 2002, there was an average of 2.5 ruptures per year. In 1999, companies were required under the OPR-99 to develop and implement pipeline integrity management programs. Ruptures declined from 2002 to 2006 and in 2008. There were, however, two ruptures on liquids pipelines in 2007. In 2009 there were five ruptures on NEB-regulated pipelines, all of which occurred on natural gas pipelines.

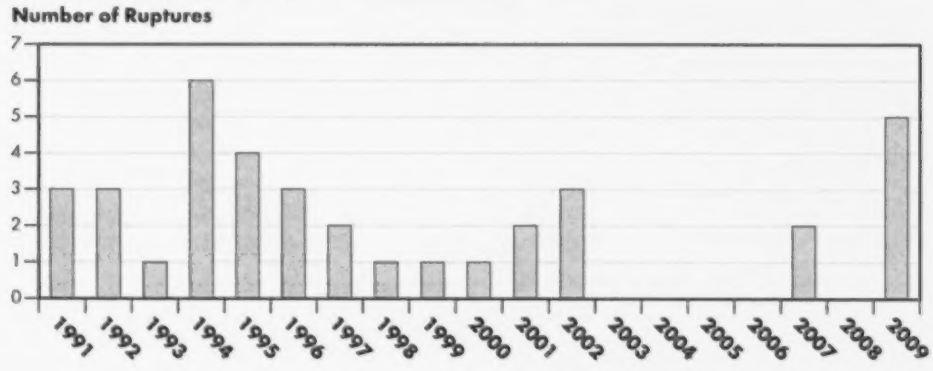
Of the five ruptures that occurred in 2009, four were caused by metal loss or cracking and the fifth occurred when a contractor employed by the pipeline company struck the line.

Figure 2.8 is a breakdown of reported ruptures on NEB-regulated pipelines and their primary causes. The primary cause of ruptures on NEB-regulated pipelines between 1991 and 2009 was corrosion due to cracking and metal loss. Cracking includes hydrogen-induced and mechanical damage delayed cracking, stress corrosion, and corrosion fatigue. Metal loss includes both internal and external corrosion. The category of "Other Causes" includes improper operation, fire and yet to be determined causes.

Some pipelines of certain construction methods have experienced a higher rupture frequency than others.[1] A number of factors have contributed to a lower rate of ruptures on pipelines, including the

FIGURE 2.7

NEB-Regulated Pipeline Ruptures 1991 – 2009



1 Jeglic, F. Analysis of Ruptures and Trends on Major Canadian Pipeline Systems. National Energy Board, Calgary, Canada, 2004.

FIGURE 2.8

NEB-Regulated Pipeline Rupture Causes

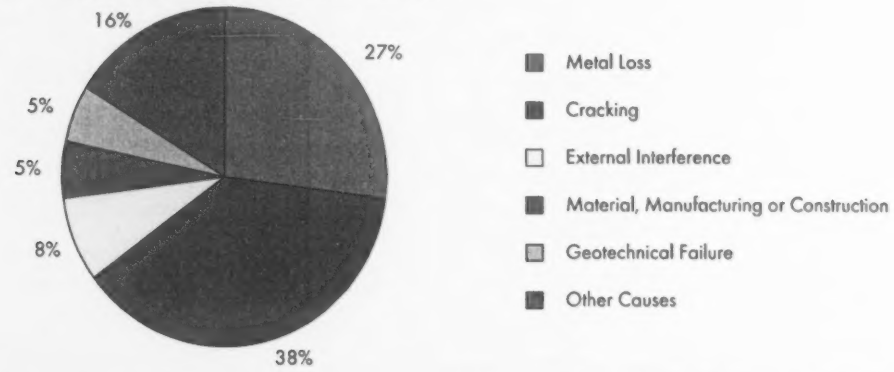
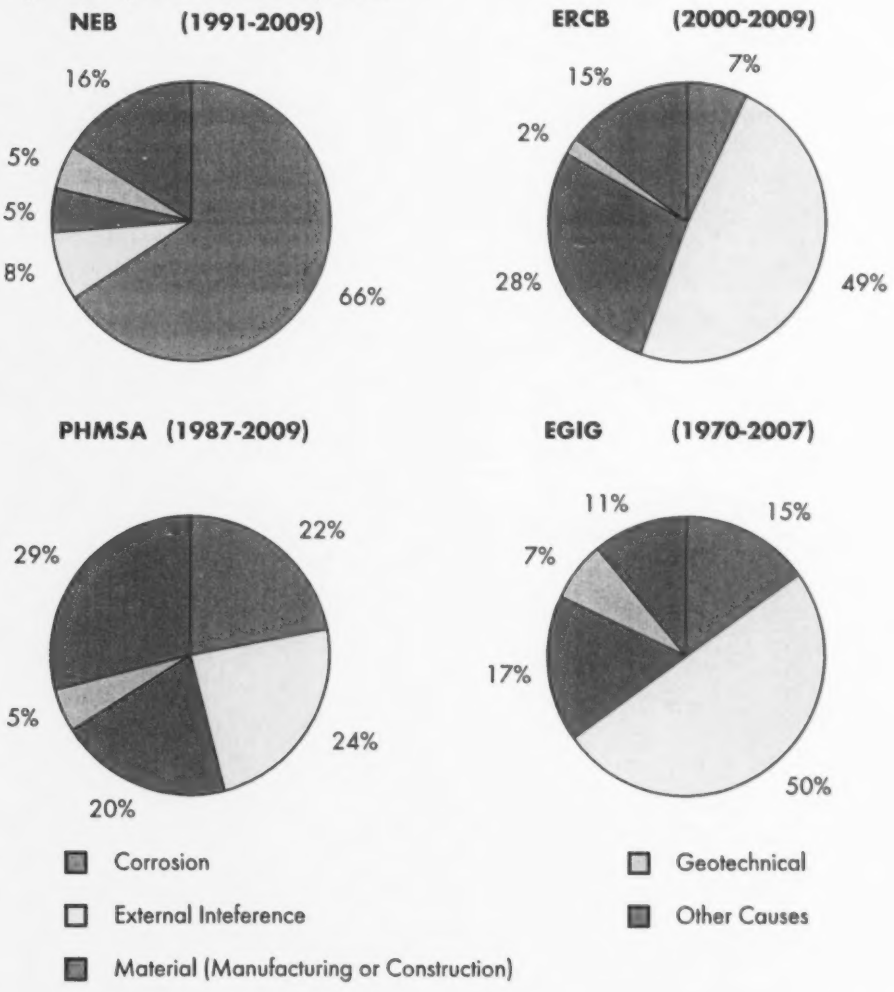


FIGURE 2.9

Pipeline Rupture Cause Comparison



quality of pipeline coatings and cathodic protection, new construction methods, effective pressure testing and well developed integrity management programs.

Rupture Cause Comparisons

The causes of NEB-regulated pipeline ruptures since 1991 is compared to those reported by the Energy Resources Conservation Board, Pipeline and Hazardous Materials Safety Administration and European Gas Pipeline Incident Data Group in Figure 2.9. While each organization examined the causes of ruptures occurring over different timeframes, the leading cause of ruptures generally remains the same from year to year.

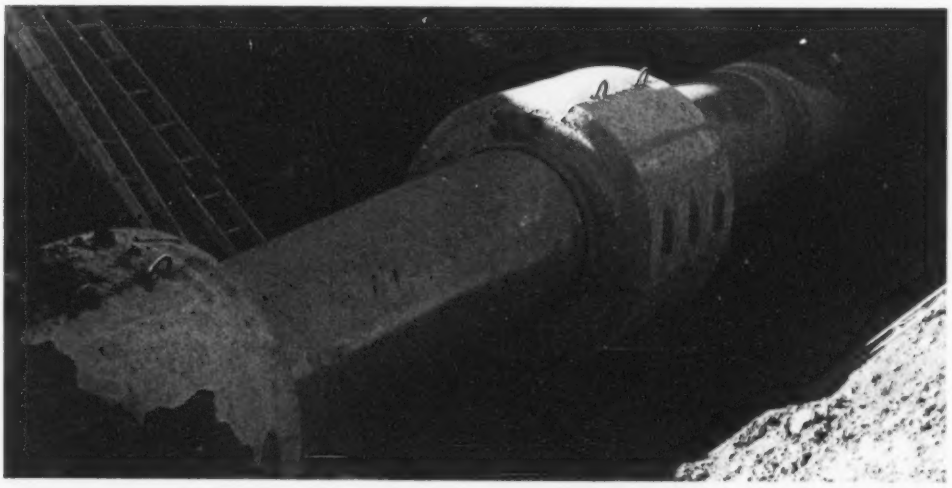
To facilitate a more representative comparison between organizations with different reporting criteria, ruptures caused by metal loss and cracking, as defined by CSA Z662, have been combined and compared to ruptures caused by corrosion. Ruptures brought on by natural causes were compared with ruptures caused by geotechnical matters and other causes. In contrast to the NEB, the leading cause of ruptures reported in other jurisdictions is external interference. Because of differences in pipeline purpose (i.e., gathering, transmission, distribution), exact comparisons are difficult, which may account for the visible differences in reported rupture or failure modes shown in Figure 2.9. The density of the ERCB-regulated pipeline network coupled with high levels of construction in the Alberta oil and gas sector may account for higher external interference rates in Alberta.

2.6 Unauthorized Activities in Pipeline Rights of Way

Unauthorized activities reported under the *NEB Pipeline Crossing Regulations (Part I and Part II)* include actions that have the potential to damage a pipeline or that may impede access to a pipeline for the purposes of maintenance or emergency response. As noted previously external interference is a leading cause of ruptures in many jurisdictions.

Unauthorized activities or events which are considered to be indicators related to pipeline integrity include:

- Movement of vehicles or equipment over pipelines;
- Construction activities with no soil disturbance;



- Construction, landscaping, or grading that results in soil disturbance; and
- Construction, landscaping, or grading, which results in pipeline contact.

The total number of unauthorized activities in rights of way between 2005 and 2007 had stabilized at approximately 70 per year. However this increased to 126 unauthorized activities reported in 2008 and again to 146 in 2009. This is significantly greater than the ten-year average of 70 per year shown in Table 2.3. Note that increasing urban encroachment on pipeline rights of way is a growing concern and may result in an increased number of unauthorized activities. Furthermore, beginning in 2008, several companies invested additional resources in landowner engagement and reinforcement of reporting criteria, which may have resulted in more accurate and complete reporting of unauthorized activities along their rights of way.

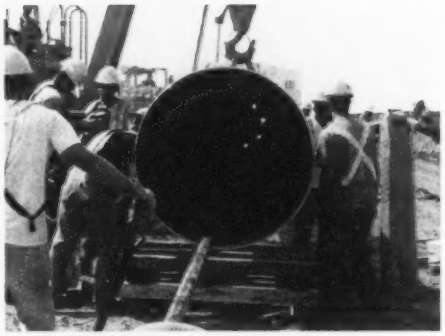
The number of pipeline contacts remains consistently low, ranging from one to two per year. In 2009, for the second year in a row, there were no reported unauthorized pipeline contacts. Overall, contacts make up less than 5 per cent of the total number of unauthorized activities.

TABLE 2.3

Unauthorized Activities on NEB-Regulated Pipeline Rights of Way

Year	Activities With No Soil Disturbance		Actvities With Soil Disturbance		Pipeline Contacts		Total
	Landowner	Contractor	Landowner	Contractor	Landowner	Contractor	
2000	5	0	12	26	0	2	45
2001	7	0	14	27	1	0	49
2002	2	0	7	13	0	1	23
2003	9	4	7	30	2	0	52
2004	4	2	12	33	1	1	53
2005	11	2	20	37	0	1	71
2006	6	4	23	32	0	1	66
2007	8	9	28	21	0	2	68
2008	7	3	65	51	0	0	126
2009	4	21	60	64	0	0	149
Average	6.3	4.5	24.8	33.4	0.4	0.8	70.2

PIPELINE ENVIRONMENTAL PERFORMANCE



NEB-regulated companies are required to develop environmental emergency response programs addressing potential upset conditions on their systems. These programs must take into consideration the magnitude of facilities and activities that could potentially be impacted during a liquid hydrocarbon release. A release of this nature has the potential to affect human health, harm wildlife, and vegetation as well as affect surface and groundwater quality.

As a performance indicator, any pipeline failure (including ruptures and leaks) resulting in a release of more than 1.5 m^3 (1 500 L) of liquid, or resulting in a significant adverse effect on the environment must be reported pursuant to the NEB OPR-99. Data regarding liquid releases of any volume or effect are requested from NEB-regulated companies under the SPI initiative.

In the case of a spill, leak or major release, the Board's role is to ensure that the companies responsible conduct Environmental Site Assessments and provide a Remedial Action Plan for cleaning up contamination at the spill site and eventual restoration to its original or equivalent capability. The NEB continues to monitor situations where remediation of soil, surface water or groundwater contamination is ongoing.

3.1 Liquid Pipebody Releases

Pipebody releases describe any leak which originates from the body of the pipe including cracks and pinholes. Pipebody liquid releases reportable under the OPR-99 are shown in Table 3.1. NEB-regulated pipelines experienced very few pipebody liquid releases between 2000 and 2009. As highlighted in Table 3.1, there were no liquid releases in 2000, 2003, 2004 or 2008 from NEB-regulated pipelines. Overall, NEB-regulated liquid pipelines have a ten-year average of 0.1 pipebody liquid releases

TABLE 3.1

Pipebody Liquid Releases

Year	Number of Liquid Pipe Body Releases >1.5 m^3	Volume of Liquid Pipe Body Releases (m^3)
2000	0	0
2001	2	3650
2002	2	52
2003	0	0
2004	0	0
2005	2	254
2006	4	39
2007	4	1182
2008	0	0
2009	2	1243

per 1 000 kilometres or one release per 10 000 kilometres of pipe. However there were two liquid pipebody releases in 2009, one of which released significant volumes of hydrocarbon. The major release occurred on private land and did not impact any water bodies in the area. The Board is monitoring ongoing remediation and company management of residual contamination.

3.2 Liquid Release Frequency Comparisons

The release frequency for NEB-regulated liquid pipelines is compared to that of reference organizations in Figure 3.1. It is important to consider that the reporting criteria for liquid releases may vary slightly from organization to organization as shown in Table 3.2. In an effort to make the comparison more meaningful, data from PHMSA and European Oil Companies Association for Environment, Health and Safety (CONCAWE) are sorted to consider only incidents which meet NEB reporting criteria.

NEB-regulated pipelines have had fewer pipebody liquid releases than in other jurisdictions in every year except 2006 and 2007. This may be due, in part, to the higher frequency of pipeline contacts by third parties experienced by PHMSA. In 2008, NEB-regulated companies did not report any pipebody liquid releases. CONCAWE data for the 2009 calendar year were not available at the time of this comparison.

FIGURE 3.1

Pipebody Liquid Release Frequency

Number of Releases per 1 000 km

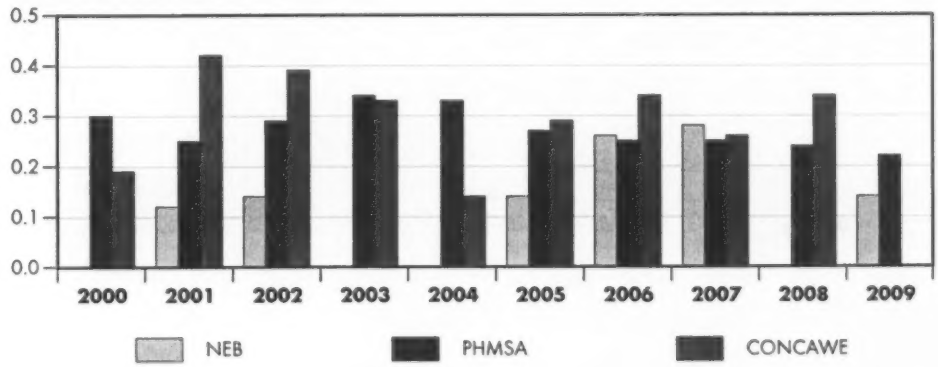


TABLE 3.2

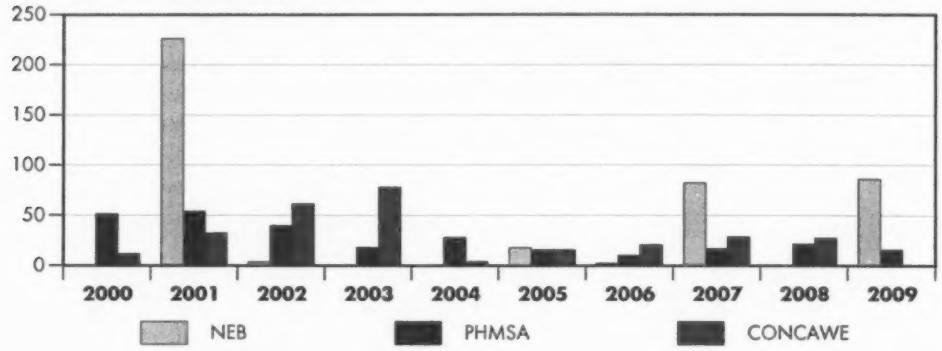
Liquid Release Reporting Criteria

Organization	Liquid Release Reporting Requirements
NEB	Any unintended or uncontained release of liquid hydrocarbons in excess of 1.5 cubic metres.
PHMSA	Loss of 8 or more cubic metres or where property damage costs exceed $50,000 USD, **or** after 7 February 2002: a release of 5 gallons (19 litres) or more.
CONCAWE	The minimum spill size has been set at 1 m^3 for reporting purposes unless there are exceptional serious safety/environmental consequences as a result of a 1 m^3 spill.

FIGURE 3.2

Pipebody Liquid Release Volume

m^3 of liquid released per 1 000 km



3.3 Liquid Release Volume Comparisons

A single large rupture or break can significantly impact the liquid release volume performance indicator. This is particularly evident in Figure 3.2 where in 2001, large events caused this indicator's upper range to be in excess of 200 m^3 per 1 000 km of liquid pipelines. As previously mentioned, a NEB-regulated facility reported a major release in 2009, resulting in an increase in reported volume. CONCAWE data for the 2009 calendar year were not available at the time of this comparison.

3.4 Operational Liquid Leaks

Operational leaks on liquid pipelines are hydrocarbon product leaks which originate from pipeline components such as flanges, valves, pumps or storage tanks and exclude leaks from pipebodies. These leaks are often contained within fenced pipeline facilities which may have a secondary containment mechanism. Most of these leaks are less than 1.5 m^3 in volume as shown in Table 3.3.

Large liquid leaks occurred in 2002 at a pump station (1 075 m^3) and in 2005 at an oil terminal (950 m^3). These incidents resulted in a high total leak volume for those years. On average, approximately 40 operational leaks per year are reported on NEB-regulated pipeline systems. Much like pipebody releases, a single large leak from pipeline components can have a significant impact on the total annual leak volume. No reference organization publishes an operational liquid leak frequency comparable to that of the NEB.

The ten-year average for the frequency of liquid leaks from non-pipebody sources is approximately three leaks per 1 000 km of pipeline. Figure 3.3 shows that in 2009, the frequency increased over levels reported since 2006.

TABLE 3.3

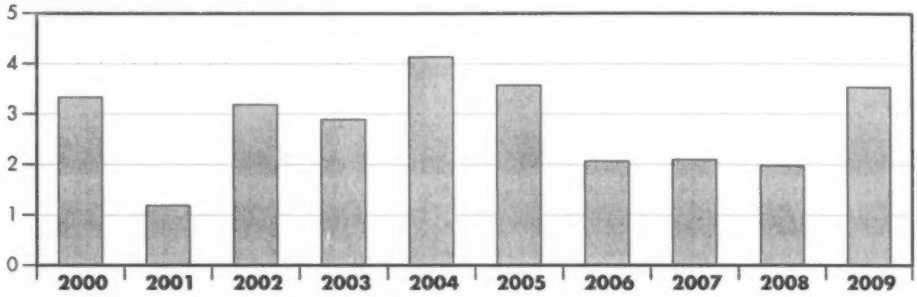
Pipeline Operational Leaks

Year	Number of Leaks ≤1.5 m^3	Number of Leaks >1.5 m^3	Total Number of Leaks	Total Leak Volume (m^3)
2000	42	2	44	102
2001	15	4	19	279
2002	38	9	47	1184
2003	43	1	44	13
2004	57	5	62	34
2005	48	3	51	1269
2006	25	7	32	322
2007	26	4	30	129
2008	25	6	31	186
2009	47	4	51	226

FIGURE 3.3

Pipeline Operational Liquid Leak Frequency

Number of leaks per 1 000 km



3.5 Non-Pipeline Liquid Spills

Liquid spills are associated with pipeline construction, maintenance and operations on both liquid and gas pipelines. These spills include small volumes of hydraulic oil, lubrication oil, valve operator fluids or equipment fuels, but exclude product leaks from liquid pipeline systems. The number and volume of these spills are shown in Table 3.4.

TABLE 3.4

Non-Pipeline Liquid Spills

Year	Number of Spills ≤1.5m³	Number of Spills >1.5m³	Total Number of Spills	Total Spill Volume (m³)
2000	227	0	227	16
2001	28	1	29	3
2002	25	0	25	2
2003	48	1	49	5
2004	64	1	65	4
2005	47	1	48	12
2006	125	0	125	3
2007	36	0	36	2
2008	16	3	19	15
2009	18	1	19	5

High levels of construction activity in 2000 and 2006 resulted in a significant number of reported spills. Overall, the average volume per spill is small, with the ten-year average being approximately 0.2 m^3 per spill. The number and volume of spills were lower than average in 2009, despite a large number of construction projects carried out that year. There were only 19 spills with a total volume of 5 m^3.

3.6 Gas Releases and Operational Gas Leaks

Gas releases are the result of pipebody failures and include both ruptures and leaks from the body of the pipe. Operational gas leaks occur through equipment, including venting from valves and seepage at flanges through gaskets.

The data in Table 3.5 do not include intentional releases of gas such as planned blowdowns. All unplanned, unintended or uncontrolled gas leaks from NEB-regulated pipelines must be reported as there is no minimum reportable volume.

3.7 Gas Release Frequency Comparison

The Board compares the frequency of gas releases from NEB-regulated gas pipelines with EGIG-regulated gas pipelines in Figure 3.4. The gas release reporting criteria for EGIG and the NEB are summarized in Table 3.6. Note that neither 2008 or 2009 EGIG data were available at the time of this comparison.

The ten-year average of the gas pipeline release frequency for NEB-regulated pipelines was approximately 0.1 releases per 1 000 km or approximately one gas release per 10 000 km. Until 2007, NEB gas release frequencies were lower than EGIG frequencies. The NEB-regulated pipeline release frequency for 2009 was 0.15 per 1 000 km, a reduction of 63 per cent from the previous year.

TABLE 3.5

Pipeline Gas Releases and Leaks

Year	Pipe Body Gas Releases	Operational Pipeline Gas Leaks
2000	1	24
2001	1	23
2002	2	11
2003	0	11
2004	4	19
2005	4	18
2006	1	22
2007	3	58
2008	6	30
2009	7	50

FIGURE 3.4

Pipebody Gas Release Frequency

Number of Releases per 1 000 km

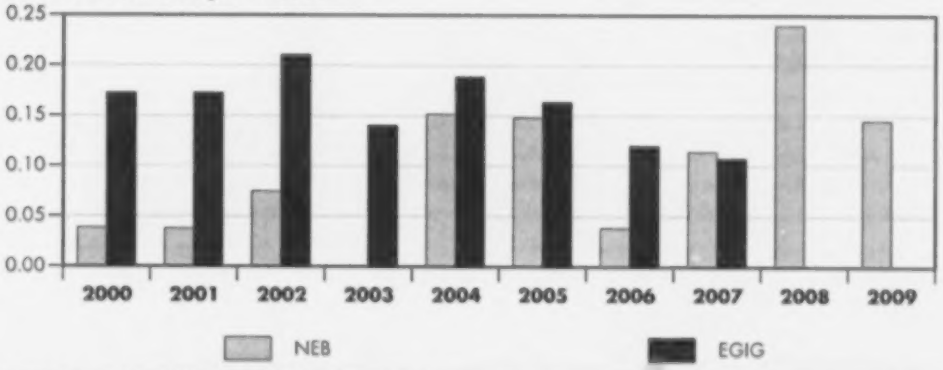


TABLE 3.6

Gas Release Reporting Criteria

Organization	Gas Release Reporting Requirements
NEB	Any unintended or uncontrolled release of natural gas.
EGIG	Any unintentional release of gas which occurs on an onshore pipeline operating at greater than 1500 kPa outside of the fenced boundaries of installations and excluding all components except the pipe.

3.8 Operational Gas Leak Frequency

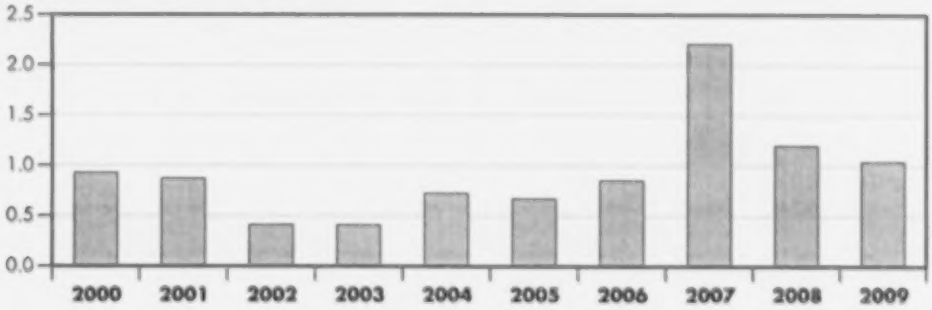
As with liquid leaks, an operational gas leak is any product leak associated with pipeline operations which originates from pipeline components such as flanges, valves, compressors or storage tanks. There were approximately 0.9 operational gas leaks per 1 000 km on NEB-regulated gas pipelines in 2009.

Due to the differences in reporting requirements for gas leaks between the NEB and other agencies, no comparison is made for operational leaks. The frequency of operational gas leaks on NEB-regulated gas pipelines is shown in Figure 3.5.

FIGURE 3.5

Operation Gas Leak Frequency

Number of leaks per 1 000 km



NEB-REGULATED PIPELINE PERFORMANCE INDICATOR SUMMARY

In summary, reporting by pipeline companies for 2009 showed that several performance indicators have improved since 2008. Table 4.1 shows a summary of performance indicators from the previous two years. In particular, injury frequencies for both contractors and employees improved in 2009.

From an environmental protection perspective, liquid releases have increased over the last year and in many instances increased above the ten-year average. As well, five natural gas pipeline ruptures in 2009 are cause for concern.

TABLE 4.1

NEB-Regulated Pipeline Performance Indicator Summary

Performance Indicator	2008	2009	Historical Average 2000-2009
Number of Fatalities (employee, contractor and third party)	2	0	0.2
Worker Injury Frequency (injuries per 200 000 worker hours)	1.0	0.5	1.1
Contractor Injury Frequency (injuries per 200 000 contractor hours)	1.2	0.5	2.0
Employee Injury Frequency (injuries per 200 000 employee hours)	0.7	0.6	0.7
Liquid Pipeline Worker Injury Frequency (injuries per 200 000 worker hours)	1.4	0.5	1.4
Gas Pipeline Worker Injury Frequency (injuries per 200 000 worker hours)	0.6	0.7	1.0
Total Number of Pipeline Ruptures	0	5	1.9
Total Number of Pipeline Contacts	0	0	1.5
Pipe Body Liquid Release Frequency (number of liquid releases per 1 000 km)	0.0	0.1	0.1
Pipe Body Liquid Release Volume Frequency (m^3 of liquid released per 1 000 km)	0.0	86.1	41.8
Number of Operational Liquid Leaks	31	51	41.1
Operational Liquid Leak Frequency (number of leaks per 1 000 km)	2	4	2.8
Pipe Body Gas Release Frequency (number of gas releases per 1 000 km gas pipelines)	0.2	0.1	0.1
Number of Operational Gas Leaks (on gas pipelines)	30	50	26.6
Operational Gas Leak Frequency (number of leaks per 1 000 km gas pipelines)	1.2	1.0	0.9
Number of Non-pipeline Spills (construction and maintenance liquid spills)	19	19	19.0
Total Number of Incidents (reportable under OPR-99)	56	83	45.1

LOOKING AHEAD

Protecting the environment and the safety of the public and the people who build and operate pipelines is of paramount importance to the NEB. Injury frequencies, incident trends and other indicators help the NEB to identify where improvement is needed.

Due to the Board's ongoing concern about major incidents and incident frequencies along its regulated pipelines, an initiative has been launched to approach incidents from a management systems perspective and to work to ensure that possible systemic issues are dealt with proactively. The Board also intends to clarify its expectations on management systems in the Onshore Pipeline Regulations – 1999 through a proposed amendment. This will assist companies to implement a systematic approach to reducing safety and environmental incidents.

The Board is committed to finding ways to improve the safety performance of the pipeline industry. The NEB's goal is to reduce the number of incidents and injuries to as low a level as possible. In 2009, the NEB continued to employ a risk-informed approach to determine the degree of regulatory oversight required for its regulated companies. This approach allows the NEB to focus compliance resources on companies that will benefit the most from regulatory oversight. As a result, NEB staff conducted 211 compliance activities in 2010.

Only continuous improvement will help ensure that pipelines remain the safest mode of energy transportation in Canada. Safety and environmental protection are of paramount importance to the NEB.

PIPELINE PERFORMANCE INDICATOR DATA

Performance Indicator data from 1 January 2009 to 31 December 2009 were submitted voluntarily to the NEB from companies owning or operating approximately 87 per cent of the total length of pipelines regulated by the NEB under the *National Energy Board Act*. Companies typically report on all NEB-regulated pipelines systems that they own. The following tables provide raw data, as provided by respondents, on pipeline length, worker hours and injuries. In addition, reference organization data on pipeline lengths and injury frequency are listed here.

TABLE A1.1

Companies Reporting Performance Indicator Data for 2009

6720471 Canada Ltd.	Kinder Morgan Canada Inc.
Alliance Pipeline Ltd.	Maritimes and Northeast Pipeline
AltaGas Ltd.	Montreal Pipe Line Limited
BP Canada Energy Company	Murphy Oil Company Ltd.
Canadian-Montana Pipeline Corporation	St. Clair Pipelines Management Inc.
Crescent Point Energy	TransCanada Pipelines Limited
Devon Canada Corporation	TransCanada Pipelines Limited (Keystone)
Enbridge Pipelines (NW) Inc.	Trans-Northern Pipelines Inc.
Enbridge Pipelines (Westpur) Inc.	Union Gas Limited
Enbridge Pipelines Inc.	Vector Pipeline Limited Partnership
Kaiser Exploration Ltd.	Westcoast Energy Inc. (carrying on business as Spectra Energy Transmission)

TABLE A1.2

NEB-Regulated Pipeline Kilometres

Year	Number of Kilometres Reported Under Voluntary Initiative	Total Kilometres Regulated
2000	39 193	42 919
2001	42 674	42 968
2002	41 555	43 124
2003	42 189	43 252
2004	41 386	43 371
2005	41 270	43 440
2006	41 454	43 530
2007	40 642	43 734
2008	40 760	46 732
2009	62 607	71 732

TABLE A1.3

Pipeline Contractor and Employee Injury Frequency Raw Data

Year	Contractor Hours	Employee Hours	Contractor Injuries	Employee Injuries
2000	6 255 390	7 034 954	55	6
2001	1 606 271	4 827 678	40	18
2002	1 357 577	5 103 983	13	4
2003	788 466	4 869 253	12	16
2004	1 573 743	4 722 044	9	12
2005	1 218 350	4 925 620	7	15
2006	2 140 650	3 811 330	17	29
2007	2 918 420	2 850 195	33	22
2008	12 432 795	6 745 368	72	23
2009	26 977 740	5 589 987	71	16

TABLE A1.4

Gas and Liquid Pipeline Worker Hours

Year	Liquid Pipeline	Gas Pipeline	Total
2000	1 124 735	12 165 609	13 290 344
2001	1 808 947	4 625 003	6 433 950
2002	1 822 637	4 638 923	6 461 560
2003	1 655 670	4 002 049	5 657 719
2004	1 615 406	4 680 381	6 295 787
2005	1 398 649	4 745 321	6 143 969
2006	1 625 244	4 326 736	5 951 979
2007	2 707 357	3 061 257	5 768 614
2008	9 949 629	9 228 533	19 178 162
2009	22 770 639	9 797 088	32 537 727

TABLE A1.5

Reference Organization Pipeline Lengths

Year	Organization	Kilometres of Gas Pipeline	Kilometres of Hydrocarbon Liquid Pipeline	Total Reported Kilometres
2000	NEB	25974	13219	39193
2000	PHMSA	469946	257440	727386
2000	CONCAWE	0	30800	30800
2000	EGIG	110236	0	110236
2001	NEB	26509	16165	42674
2001	PHMSA	455862	255437	711299
2001	CONCAWE	0	35575	35575
2001	EGIG	110236	0	110236
2002	NEB	26752	14803	41555
2002	PHMSA	475538	258672	734210
2002	CONCAWE	0	35592	35592
2002	EGIG	109524	0	109524
2003	NEB	26943	15245	42189
2003	PHMSA	472877	255219	728096
2003	CONCAWE	0	36422	36422
2003	EGIG	114285	0	114285
2004	NEB	26374	15012	41386
2004	PHMSA	475165	253403	728568
2004	CONCAWE	0	35383	35383
2004	EGIG	122168	0	122168
2005	NEB	27002	14269	41270
2005	PHMSA	471693	252598	724291
2005	CONCAWE	0	34826	34826
2005	EGIG	122500	0	122500
2006	NEB	25888	15566	41454
2006	PHMSA	469990	252530	722520
2006	CONCAWE	0	35390	35390
2006	EGIG	125000	0	125000
2007	NEB	26275	14368	40642
2007	PHMSA	471949	257534	729483
2007	CONCAWE	0	34700	34700
2007	EGIG	129719	0	129719
2008	NEB	25071	15715	40786
2008	PHMSA	475835	262867	738702
2008	CONCAWE	0	35486	35486
2008	EGIG	not available	not available	not available
2009	NEB	48165	14442	62607
2009	PHMSA	473963	267342	741306
2009	CONCAWE	not available	not available	not available
2009	EGIG	not available	not available	not available

TABLE A1.6

Reference Organization Injury Frequency Data

Year	Source	Contractor Injury Frequency	Employee Injury Frequency	Worker Injury Frequency
2000	NEB	1.76	0.17	0.92
2000	HRSDC	not available	0.51	not available
2000	CAPP	3.13	1.05	2.49
2001	NEB	4.98	0.75	1.80
2001	HRSDC	not available	0.56	not available
2001	CAPP	2.61	0.89	2.06
2002	NEB	1.92	0.16	0.53
2002	HRSDC	not available	0.30	not available
2002	CAPP	1.86	1.02	1.64
2003	NEB	3.04	0.66	0.99
2003	HRSDC	not available	0.33	not available
2003	CAPP	2.15	1.34	1.80
2004	NEB	1.14	0.51	0.67
2004	HRSDC	not available	0.42	not available
2004	CAPP	1.90	1.00	1.64
2005	NEB	1.15	0.61	0.72
2005	HRSDC	not available	0.32	not available
2005	CAPP	1.74	0.95	1.52
2006	NEB	1.59	1.52	1.55
2006	HRSDC	not available	0.34	not available
2006	CAPP	1.74	0.83	1.48
2007	NEB	2.26	1.54	1.91
2007	HRSDC	not available	0.32	not available
2007	CAPP	1.31	0.80	1.15
2008	NEB	1.16	0.68	0.99
2008	HRSDC	not available	not available	not available
2008	CAPP	1.25	0.64	1.08
2009	NEB	0.53	0.57	0.99
2009	HRSDC	not available	not available	not available
2009	CAPP	not available	not available	not available

Data Sources

2009 CAPP Stewardship Report, published by the Canadian Association of Petroleum Producer in January 2010.

Performance of European cross-country oil pipelines – Statistical summary of reported spillages in 2008 since 1971, CONCAWE Report no. 4/10, published June 2010.

7th EGIG Report, 1970-2007 Gas Pipeline Incidents, Document No. EGIG 08.TV-B.0502 published in December 2008.

ERCB Provincial Surveillance and Compliance Summary 2009, ST57-2010, published August 2010.

Occupational Injuries Among Canadian Employers Under Federal Jurisdiction, 2002–2007. Published by HRSDC.

All PHMSA data retrieved from data files available on http://phmsa.dot.gov.

Information provided annually to the NEB through the Safety Performance Indicators Initiative.